RESISTANCE DEVICES, TOTAL-BODY EXERCISE MACHINES OUTFITTED THEREWITH, AND EXERCISE METHODS USING SUCH DEVICES AND MACHINES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Patent Application No. 60/259,293, filed on December 29, 2000, and incorporated herein by reference.

TECHNICAL FIELD

This invention relates to exercise machines, and more particularly to resistance devices for multiple uses, including for converting aerobic lower-body exercise machines to total-body exercise machines by providing an upper body exercise component.

BACKGROUND OF THE INVENTION

The exercise and fitness industry continues to be an area of high growth, marked by a proliferation of exercise machines. Among many of the most popular exercise machines are aerobic leg exercise machines such as but not limited to treadmills, air walkers/gliders, upright and recumbent bicycle machines, torso-twisting disks, cross-trainers, steppers, elliptical exercise machines, cross-country and downhill ski machines, trampolines, squat machines, rowing machines, stretching machines, abdominal machines and the like.

Many embodiments of these machines have some sort of handrail, grip, or handlebars for resting the arms, while other embodiments provide nothing to hold on to, and still other embodiments have some type of mechanism to enable simultaneous exercising of the arms and/or upper body. Such mechanisms may include but are not limited to poles, shafts, or arms that, for example, move back and forth. Machines with such mechanisms for exercising both the legs or lower body and arms or upper body are often referred to as "dual action" or "total body" exercise machines. In fact, the

inventor coined the phrase "total body" and originated the concept of extending the "total body" idea to exercise machines beyond cross-country ski machines.

Dual action or total body machines have a number of benefits, including offering a more complete total body exercise including both the arms and/or upper as well as the lower body. The increased work raises the user's metabolism and heart rates more quickly than single action machines, and maintains the higher metabolism and heart rate throughout the workout. Such machines are therefore more efficient, providing more exercise in less time. The arm exercise features also strengthen, tone, or shape the arm muscles during the aerobic workout. The overall safety of machines with such features is also typically enhanced, as the arm exercise mechanisms typically provide improved balance to the user as compared to embodiments without such mechanisms.

There are, however, a number of disadvantages inherent in presently available dual action machines. Typically, the upper body or arm motion provided by such machines is an unnatural motion, requiring the user to push forward and/or pull backward. For example, certain cross-country ski machines, have a cable or reel system for the arms that is mounted in front of the user. The front-mounted arm system produces an awkward, pull-down/backward motion on the backswing of the arms. This causes the body to lean so uncomfortably forward that a separate structure is typically provided as a stomach/mid-section support.

Additionally, arm-exercise mechanisms, such as poles, on existing machines typically require the user's arms to be raised above the waist during the entire push/pull cycle. The poles or exercise arms are generally mounted in a fixed position, in front of the user, often making the user lean forward, straining the lower back and neck, rather than being in a more comfortable, upright posture position. Additionally, the poles or exercise arms typically travel in a fixed arc in a single plane, thus limiting the range of motion of the arms and upper body to a predetermined distance traveled and to a single plane of motion that is unnatural.

The poles or arms may often be dependent on or tied into the motion of the leg exercise device. This limits the motion of the arms or upper body to the motion of the legs or lower body, typically in a one-for-one cycle. Poles that are dependent upon the leg motion typically keep moving, even when not engaged by the exerciser. This creates the safety risk of striking the user. Also, because the poles or exercise arms keep moving and do not fold away, the user is basically forced to use them and has no choice of exercising in a non-dual-action, arms-free mode because the poles interfere with a natural arm swing. In many machines, the arms or poles do not fold away or fold down flat for more compact storage.

Arm exercise poles or other arm-exercise devices currently available typically must be held in a closed grip fashion by the hands, which may cause fatigue, strain or cramping of the hand, wrist, and/or arm. A closed grip may also have the undesirable effect of raising blood pressure. Additionally, the act of pushing a pole forward may put considerable pressure on the palm of the hand, causing a discomfort in a sensitive pressure point.

In summary, current dual action exercise machines typically require arm motion that may be unnatural and/or uncomfortable and in some circumstances may be unsafe. Additionally, the various arm exercise mechanisms known in the art are often relatively expensive. Thus, there is a need in the art for a dual action, total body, arm exercise mechanism that addresses some or all of the deficiencies noted above.

SUMMARY OF THE INVENTION

One aspect of the invention comprises an exercise reel comprising an elongated tension member having first and second ends; a user engagement connected to the elongated tension member first end for engaging a body appendage; a spool connected to the elongated tension member second end and on which the elongated tension member is adapted to be wound; a resistance mechanism for resisting unwinding of the spool, the resistance mechanism comprising a rotatable disk and a pair of calipers for engaging the rotatable disk; and a retraction mechanism for automatically rewinding the spool. In one embodiment, the retraction mechanism comprises a coil spring, the

reel comprises a mounting connection for mounting to a surface, and the reel further comprises a roller clutch to disengage the resistance mechanism during rewinding of the spool and a housing for enclosing the spool, the rewind mechanism, and resistance mechanism. The resistance mechanism may be adjustable. The adjustment mechanism may be remotely actuated and/or motorized. In a preferred embodiment, the user engagement comprises a hand loop that is padded, adjustable, or a combination thereof.

Another aspect of the invention comprises an exercise machine, preferably an aerobic lower-body exercise machine comprising at least one exercise reel for exercising the upper body as described above. Suitable lower body exercise machines may include but are not limited to: treadmills, air walkers/gliders, upright and recumbent bicycle machines, torso-twisting disks, cross-trainers, steppers, elliptical exercise machines, cross-country and downhill ski machines, trampolines, squat machines, rowing machines, stretching machines, abdominal machines and the like. The exercise reel may comprise a forward-stroke arm exercise reel positioned behind a user to provide resistance to a forward swinging motion of an arm of the user while allowing the user's arm to perform the forward swinging motion in a natural, free-swinging arm position. For such use, the elongated tension member may consist of a length sufficient to extend from a mounting point of the reel on the machine to a furthest point of a user's arm swing from the mounting point, and the spool is sized to hold substantially all of the elongated tension member length.

In one embodiment, the exercise machine may comprise at least two arm exercise reels, a first reel adapted for use by a left arm of the user and a second reel adapted for use by a right arm of the user.

In some embodiments, the exercise machine may comprise a support structure, such as a padded support adapted to engage the back or buttocks of the user, mounted behind the user for minimizing the possibility of the user being pulled backward off of the machine by the resistance of the arm exercise reel.

In another embodiment, the exercise machine may comprise a single arm exercise reel comprising a first elongated tension member adapted for use by a left arm

of the user, a second elongated tension member adapted for use by a right arm of the user, each elongated tension member having a portion engaged by the reel to provide resistance to the forward swinging motion of each arm. The first elongated tension member and the second elongated tension member may comprise portions of a single elongated tension member and the portion engaged by the reel may comprise a middle portion of the single elongated tension member. The resistance mechanism may comprise a knob screw having a shaft coaxial with the spool and a spring coaxial with the knob screw shaft and having opposite ends, one end abutting the knob of the knob screw and the other end abutting the spool such that as the knob is tightened, the spring compresses and exerts increased force upon the spool.

Another aspect of the invention comprises a free-standing exercise device comprising at least one exercise reel as described herein. In one free-standing embodiment, the user engagement may comprise a crossbar for engagement by both hands of the user. Another embodiment may comprise a platform having at least one exercise reel comprising an elongated tensioned device strung between the platform and a user engagement such that the user may lie or stand upon the platform and perform an upper body exercise against the resistance of the reel, optimally while simultaneously performing a lower body exercise such as jumping, running, kneebends, stretching, and the like.

Yet another aspect of the invention comprises an exercise machine for exercising a user, the machine comprising an upper body exercise component comprising one or more resistance devices adapted to provide resistance to a forward swinging motion of an arm of the user while allowing the user's arm to perform the forward swinging motion in a natural, free-swinging arm position. The resistance device comprising a elongated tension member having first and second ends, and a user engagement connected to the elongated tension member first end, wherein the user engagement is padded, adjustable, or a combination thereof. In one embodiment, the resistance device comprises a spool connected to the elongated tension member second end and on which the elongated tension member is adapted to be wound, a resistance mechanism for resisting unwinding of the spool, and a retraction mechanism for

automatically rewinding the spool. In another embodiment, the resistance mechanism comprises an elastic member having adjustable resistance.

The exercise machine may comprise at least one user engagement rest positioned in front of the user for holding the user engagement when not in use by the user. The resistance mechanism may be mounted behind the user, or if the resistance device is not located behind the user, the machine may further comprise a guide such as a pulley, roller, or the like mounted behind the user for directing the elongated tension member to the user from the resistance device. In such an embodiment, the resistance device may comprise a spring having a first end connected to the exercise machine and a second end connected to the elongated tension member second end. In another such embodiment, the resistance device may comprise a single reel comprising at least one elongated tension member having a portion engaged by the reel, a first user engagement adapted for use by a left arm of the user, and a second user engagement adapted for use by a right arm of the user.

Another aspect of the invention comprises methods of exercising comprising using any of the devices described herein. One method of exercising, comprises a user engaging in total body exercise, including engaging in upper body exercise by swinging the user's arms in a natural, multi-planar, free-swinging motion against a tensile resistance force directed from a point behind the user and transmitted by an elongated tension member, the elongated tension member having a user engagement that is engaged by means other than a closed grip, such as in an open, loose grip.

Yet another aspect of the invention comprises an exercise machine comprising a lower body workout component and an upper body workout component, the upper body workout component comprising at least one pole providing resistance to movement thereof, the pole having freedom to move in multiple planes. The pole may comprise a ball and socket interface with the machine, or the pole may be axially attached to a helical spring that is connected to the machine. In an ball and socket embodiment wherein the resistance is adjustable, the ball and socket interface may comprise a member for increasing and decreasing radial pressure on the ball.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1A is a perspective view illustration of a user on an exemplary treadmill outfitted with exemplary exercise reels.

FIG. 1B is a perspective view illustration of a user on a treadmill similar to that of FIG. 1A but with a single reel embodiment.

FIG. 1C is a perspective view illustration of a single reel embodiment similar to that of FIG. 1B but with guides for the cable.

FIG. 2A is an exploded plan view illustration of an exemplary spring-return cable spool mechanism.

FIG. 2B is perspective view illustration of the partially assembled exemplary spring-return cable spool mechanism of FIG. 2A, with the housing shown removed to reveal the inner workings.

FIG. 3A is an illustration of a hand loop user engagement.

FIG. 3B is a plan view illustration of an exemplary micro-hook/micro-loop adjustable hand loop embodiment.

FIG. 3C is an illustration of an exemplary adjustable cable-through-ring hand loop embodiment.

FIG. 4A is a plan view illustration of an exemplary single reel embodiment.

FIG. 4B is a partial cross-section side view illustration of an exemplary resistance mechanism on the single reel embodiment shown in FIG. 4A.

FIG. 5A is an illustration of an exemplary cross-country ski machine having two forward-stroke exercise reels.

FIG. 5B is an illustration of an exemplary elliptical machine having two forward-stroke exercise reels, two backward-stroke exercise reels, and a support structure.

FIG. 5C is an illustration of an exemplary trampoline having two forward-stroke exercise reels and a support structure.

FIG. 5D is an illustration of an exemplary stepper having two forward-stroke exercise reels and a support structure.

FIG. 5E is an illustration of an exemplary exercise bicycle having two forward-stroke exercise reels.

FIG. 5F is an illustration of an exemplary rowing machine having two backward-stroke exercise reels.

FIG. 5G is an illustration of an exemplary torso-twisting disk exercise machine having two forward-stroke exercise reels.

FIG. 5H is an illustration of an exemplary air walker/glider exercise machine having two forward-stroke exercise reels.

FIG. 6A is an illustration of an exemplary exercise reel in a freestanding floor-mounted configuration with a crossbar as a user engagement.

FIG. 6B is an illustration of an exemplary exercise reel in a freestanding wall-mounted configuration with a crossbar as a user engagement.

FIG. 6C is an illustration of an exemplary exercise reel in a freestanding ceiling-mounted configuration with a crossbar as a user engagement.

FIG. 6D is an illustration of an exemplary freestanding platform having two exercise reels mounted thereto for upper body exercise.

FIG. 6E is an illustration of an exemplary freestanding platform having a single-reel exercise reel embodiment mounted thereto.

FIG. 6F is an illustration of an exemplary freestanding platform having a two exercise reels mounted thereto for leg exercises.

Fig. 7 is a perspective view of an exemplary treadmill embodiment having a plurality of exercise reels mounted thereon.

Fig. 8 is a side view of an exemplary treadmill embodiment having helical spring resistance devices mounted underneath the treadmill.

FIG. 9 is a plan view of an exemplary treadmill embodiment having a single reel mounted to the front thereof, with guides to direct the cable to a point behind the user.

FIG. 10 is a partial longitudinal section illustration of an exemplary pole mounted on a helical spring for mounting to an exercise machine.

FIG. 11 is an illustration of an exemplary treadmill having poles mounted thereon with a ball and socket resistance mechanism.

FIG. 12 is an illustration of an exemplary stepper exercise machine having the resistant units attached to the steps.

FIG. 13 is an illustration of an exemplary foot surface for providing enhanced balance for a user.

DETAILED DESCRIPTION OF INVENTION

The invention will next be illustrated with reference to the figures. The figures are intended to be illustrative rather than limiting and are included herewith to facilitate the explanation of this invention.

Referring now to FIG. 1A, there is shown a user 14 on an exercise machine 10, namely a treadmill. Machine 10 has two resistance units of this invention, namely exercise reels 12, mounted behind user 14 to be used for exercising the user's arms. Reels 12 are positioned to enable the natural, free-swinging back and forth motion of arms 16 of user 14. User 14 swings each arm 16 forward in an upward arc along arrow A, extending from below the waist or preferably behind the user's body at or to the rear of point B, and moving alongside to point C in front of the user's body. Most of the effort is exerted by pulling and lifting the arms on the upswing (in the direction of arrow A), while letting the arms swing backward freely on the downswing (opposite the direction of arrow A).

One aspect of the invention allows the user to maintain this natural arm swing motion while exercising, and in so doing provides a superior exercise workout. Reels 12 may be permanently attached to exercise machine 10 or may be detachable, and may be used to retrofit a pre-existing machine. Although mounting the devices behind the user for use in providing an arm workout is one preferred embodiment, the resistance devices of this invention may be placed anywhere on an exercise device in relation to the user, for use in working-out any portion of the user's body. Although any number of resistance units may be provided, a preferred embodiment comprises two resistance units, one for each arm and/or leg. Although four units may be provided so that both legs and both arms may be exercised simultaneously, one preferred embodiment comprises two units that may be adjustable for use with either arms or legs.

The resistance units may be permanently affixed to the machine, or may be detachable and removable. The resistance units may also be fixed in a particular place on the machine, but are preferably adjustable in one or more dimensions. For example, as shown in Fig. 7, each reel 12 may be mounted on a shaft 700, each shaft pivotable in the direction of arrow Z to provide adjustability forward and backward relative to the user. Each reel may also be slidable up and down shaft 700 along arrow Y, such as on a track, providing vertical adjustability. Although not shown in Fig. 7, shaft 700 may be jointed to allow pivoting toward and away from each other, to provide right-to-left adjustability relative to the user. The arrangement shown in Fig. 7 is

merely one example of how resistance mechanisms can be provided with adjustability in more than one direction. Any other structural arrangements known in the art may be used to provide one, two, or three directions of adjustability (up/down, forward/back, or left/right). Shafts 700 may be provided as part of the original equipment for the exercise machine, or may comprise a retrofit kit for attaching to existing exercise machines.

The resistance units may allow for adjustment in the amount of resistance, but units that are not adjustable may also be used. The adjustable resistance may be continuously adjustable within a certain range, may comprise incremental, stepped, non-continuous adjustment, or a combination thereof. For example, a kit may be provided having a first set of resistance devices for providing continuous adjustment between 1-5 pounds of resistance, and a second set of resistance devices interchangeable for the first set for providing continuous adjustment between 5-10 pounds of resistance. The noted ranges of resistance are merely exemplary, however, as any range of resistance may be provided.

Referring now to FIGS. 2A and 2B, there is shown an exemplary exercise reel 12 in further detail. Reel 12 is depicted in Figs. 2A and 2B as a spring-return cable spool reel, but other types of reels may also be used. In the embodiment shown in Figs. 2A and 2B, however, cable 217 is attached to cable spool 207 at one end and comprises user engagement means, such as hand loop 219 on the opposite end. Although the cable may preferably be a plastic-coated, twisted-metal cable as is well known in the art, the term "elongated tension member" may be used herein to generically refer to any type of cable, line, cord, tubing, band, strip, rope, chain, string, or other means known in the art suitable for transmitting tensile resistance to the arm movement of the user from spool 207. For simplicity, however, the embodiments described from this point forward are described with respect to a "cable" (except where specific to other types of tension members), but it should be understood that any applicable elongated tension member may be substituted for the cable described in any of these embodiments.

Cable 217 may be non-elastic or may have some elasticity. Cable 217 is preferably just long enough to stretch from the mounting location of the reel to the furthest point of the user engagement from the mounting location during a standard arm

swing. Thus, for a reel mounted behind the user, the length corresponds to the length of a full forward arm swing, and for a reel mounted in front of the user, the length corresponds to a full backward arm swing. The spool is preferably sized to just hold substantially all of the length of the cable. By "substantially all," it is meant the portion of the cable not including user engagement 219 or any portion of the cable between the cable thimble 218 and the user engagement. By "just hold" it is meant that the spool is preferably not substantially oversized, so as to conserve weight and size and to minimize cost. Restricting the length of cable and spool capacity enables a more compact unit than if, for example, the length of cable were indiscriminately long and the size of the spool were correspondingly large. For example, previously known reel devices for use in aquatic training would be unreasonably bulky for use in the present application.

In the preferred embodiment, the user engagement is a comfortable, "hands-free" design that may be in the form of a padded, soft, non-chafing hand loop 219, such as is shown in FIG. 2B, or any other type of strap or grip that fits around the hand without requiring a closed grip by the hand. A material such as a dense foam rubber may provide the padded, soft, and non-chafing qualities. The user engagement may comprise any of the suitable mechanisms known in the art for enabling engagement by or attachment to a portion of the upper body, however, such as but not limited to handles, grips, bars, wraps, gloves, straps, cuffs, and the like. In other embodiments, where the exercise reel of this invention is used for the exercise of other muscles, the user engagement may be any device for engaging any part of the body, including the feet or legs, the waist, the torso, the head, the shoulders, and the like. Thus, although referred to as a "hand loop" herein, it should be understood that loop 219 may be used for engagement of other parts of the body. The user engagement may be permanently attached to or detachable from cable 217. Upper body user engagements may be designed to be attached to, engaged by, or held by any portion of the arms, wrists, hands, or fingers of the user. The user engagement may be securable to the arm or hands by any mechanism known in the art, such as but not limited to the user grasping or holding the means, or the means being secured to the user by any type of fastener such as one or more buckles, Velcro® fasteners, snaps, pressure fittings, hooks, loops, clips, and the like. User engagements for other parts of the body may be securable to

the feet, legs, waist torso, head, shoulders, and the like. The user engagement is preferably padded for comfort, and/or lined for sweat absorption.

Although the user engagement may be a member suitable for gripping by the user, a loop is preferred because it may simply engage the user's hand 17 in a naturally open position as shown in FIG. 3A with the loop passing between the user's thumb 19 and forefinger 20. Loop 219 may also be adjustable for sizing and comfort, while allowing for a quick release of the hands. For example, as shown in FIG. 3B, loop 319 comprises a section 302 of micro-hooks and mating section 304 of micro-loops (or vice versa), such as a commonly known Velcro® fastener, that enables the diameter D of loop 319 to be adjusted. Any number of equivalent devices for providing adjustability are known in the art and may be used, however, such as but not limited to snaps, buttons, a "cable-through-ring" mechanism 419 such as is shown in FIG 3C with cable 417 and ring 418, and the like.

Returning now to Figs. 2A and 2B, reel 12 further comprises a split housing having a left component 201 and right component 202 that enclose the moving parts. Shaft end caps 220 are attached to either end of shaft 205 to keep the assembled housing in place. Reel 12 also may comprise a swivel mount, such as yoke 203 and swivel tongue 204, that allows the reel to swivel with respect to its attachment point to the exercise machine. Although the yoke / swivel tongue mechanism allows only a single degree of freedom (pivoting in the either direction along arrow X), the swivel mount may comprise multiple swivel mechanisms, each of which provides additional degrees of freedom, or may comprise a single mechanism, such as a ball-and-socket mechanism that provides multiple degrees of freedom. Instead of being attached to shaft 205 running through cable spool 207, the swivel mount may also be attached to one or both of the housing components 201 or 202. A swivel mounting, in general, may protect the reel mechanism by reducing stresses on the reel. In other embodiments, however, the reel may be attached to the exercise machine, mounting bracket, wall, bench, platform, or the like, by a non-swiveling mechanism.

Reel 12 preferably has a retraction mechanism so that cable 217 is wound back on the reel as the user's arm moves backward on the back swing. As shown in

FIG. 2A, an exemplary retraction mechanism embodiment comprises a retractor spring 206, such as a coil spring. Other retraction mechanisms may also be used. Spring 206 is loaded as cable 217 is unwound from spool 207 (and also exerts some resistance) and then automatically springs back to rewind the cable as the user moves hand loop 219 back below the waist and behind the body so that it can be pulled forward again to point C on the upswing to complete a full cycle of the arm swing. The retraction mechanism also enables reel 12 to retract cable 217 so that cable thimble 218 abuts reel 12 when the reel is not being engaged by a user, to neatly store the cable when not in use. Cable thimble 218 prevents too much cable, including hand loop 219, from being pulled into housing 201 and 202. Opening 230 in the housing is sized to stop thimble 218 from being drawn inside.

The cord on the reel mechanism may fully retract up to thimble 218, providing compact storage. In other embodiments, holders may be provided forward of the user for resting the user engagements where they may be readily picked up and put down by the user. For example, as shown in Fig. 1A, console 18 in front of user 14 may comprise wings 20 having upright posts 22 around which the loops 219 (shown in Fig. 2B) may be optionally placed. So, a user wanting to discontinue the arm exercise portion of the workout for a period of time may merely continue exercising his legs while temporarily putting the loops 219 down on posts 22 where they can be readily picked up again without discontinuing the leg workout.

Although shown in FIG. 2A as a spring 206, the retraction mechanism on reel 12 may be of any type known in the art, however, such as but not limited to a spring, weight, or elastic member. The cable retraction mechanism may even be motorized, if desired. The retraction mechanism may be adjustable to provide a range of retraction forces or may be non-adjustable. In the exemplary embodiment shown in FIG. 1B and described herein later in which a single reel has a cable with one end used by the user's right arm and the other end used by the user's left arm, the retraction mechanism for one arm is powered by the forward stroke of the opposite arm.

Reel system 12 also has at least one resistance mechanism. In some embodiments, the resistance mechanism and retraction mechanism may be the same

mechanism, or at least a portion of the resistance mechanism may also comprise at least a portion of the retraction mechanism. In other embodiments, at least some substantial portion of the resistance mechanism may be separate from the retraction mechanism. For example, spring 206 provides some resistance force as well as the retraction force. In the embodiment shown in FIGS. 2A and 2B, the resistance mechanism additionally comprises a brake disk 211 and a pair of caliper arms 212 and 213. The element providing the resistance may be anything known in the art, however, such as but not limited to a spring; an elastic member, including a tension band or ring; a weight; a friction brake, including a brake on a reel or on the cable itself; a pressure pad; a screw; a device using magnetic, hydraulic, or pneumatic resistance; a bendable shape memory material such as a composite (i.e. a BOWFLEX® rod); or the like.

The resistance mechanism may be adjustable, such as for example, by turning caliper adjustment knob 216 which is connected to shaft 214. Shaft 214 is coaxially mounted within spacer 215 and has a threaded end that interfaces with threaded portion of left caliper arm 212 to change the distance between left caliper arm 212 and right caliper arm 213, as shown in FIG. 2A. Shaft 214 protrudes through housing component 202 via opening 221, allowing adjustment knob 216 to be accessible without removing the housing.

The resistance mechanism may also be non-adjustable. For example, if permanently set to be used for an aerobic workout, the arm mechanism may be non-adjustable and set to provide less than about 5 pounds of resistance. If the arm mechanism is designed to provide a simulation of weight exercise, the arm mechanism may be adjustable to offer a range of different resistance forces that may typically exceed 5 pounds. This range of resistance forces may be infinitely adjustable within the range along a continuum, or the range may be adjustable stepwise.

As shown in FIGS. 2A and 2B, the resistance mechanism typically further comprises a clutch mechanism, such as roller clutch 210 that disengages from spool clutch hub 208 when spool 207 spins in the direction for retraction of cable 217, and engages it again when the cable causes the spool to spin in the opposite direction. The

clutch mechanism allows retractor spring 206 to quickly rewind cable 217 on spool 207 without resistance. Embodiments without a clutch may also be provided.

Although shown in FIG. 1A with two reels 12 with independent cables 217 coming from each reel 12, referring now to FIG. 1B, a single reel 112 may be shared by both arms. Reel 112, as shown in greater detail in FIGS. 4A and 4B, may comprise one cable 117a for one arm and another cable 117b for the other arm, each cable wound on spool 107 in a different direction. Cables 117a and 117b may be two distinct cables or may comprise a common cable with its middle section wound around spool 107. Reel 112 as shown in Fig. 1B may be mounted so that it can swivel up and down to accommodate users of different height while assuring that the tension forces on the cable are perpendicular to the axis of the spool. Referring now to FIG. 1C, to further facilitate a natural, straight forward and backward arm motion and to keep the cable from touching the back of the user's body, the single reel embodiment may further comprise a set of pulleys or guides 114 which move the origin point of the resistance force more toward the outside of and behind the body.

As shown in FIG. 4B, resistance may be provided in the single reel embodiment by a spring 110 mounted around shaft 120 of knob screw 122. As knob screw 122 is screwed downward to advance threads 123 into nut 126, which abuts one end of spool 107 via washer 128, knob 124 compresses spring 110 so that the pressure exerted by the spring on spool 107 increases. FIG. 4B shows only one exemplary mechanism for providing resistance, however, and other mechanisms may be used as are known in the art without limitation. The advantages of a single reel embodiment include the simplicity of design and the economic benefit of having only a single reel and cable. Single reel embodiments may limit the motion of one arm to the opposite motion of the other arm, however, which in some circumstances may not be desirable. Furthermore, single reel embodiments can provide only the same resistance for each arm, and the cable is not fully retractable when not in use.

Although arm exercise reels 12 are particularly useful for providing total body workouts for aerobic leg exercise machines, such as on a cross-country skiing machine 510 as shown in FIG. 5A, an elliptical machine 520 as shown in FIG. 5B, a

trampoline 530 as shown in FIG. 5C, a stepper 540 as shown in FIG. 5D, an exercise bike 550 as shown in FIG. 5E, a torso-twisting disk 560 as shown in Fig. 5G, or an air walker/glider 570 as shown in Fig. 5H, the invention is not limited thereto. This invention may be used in conjunction with any type of exercise machine, such as but not limited to home gyms, strength training machines, upper body exercise machines, and the like, including specific machines such as but not limited to treadmills, air walkers/gliders, upright and recumbent bicycle machines, torso-twisting disks, cross-trainers, steppers, elliptical exercise machines, cross-country and downhill ski machines, trampolines, squat machines, rowing machines, stretching machines, abdominal machines and the like.

Because of the backward resistance force applied by the arm-exercise mechanism, in some embodiments it may be desirable to include one or more attendant structures for facilitating the invention. Such structures may include a support structure behind the user, and/or, for devices such as steppers with a limited area for engaging the foot, an oversized or at least full-sized foot support. For example, as shown in Fig. 13, foot support 1300 has a length L and width W greater than the comparative length and width of a human foot 1302, and optionally further comprises a raised lip or railing 1304 on the periphery to make it easier for the foot to stay in the foot support area. The foot support area surface 1306 may optionally comprise a high-traction material.

Exemplary support structures 60 behind the user are illustrated in FIGS. 5B, 5E, 5G and 5H, and may be provided to minimize the possibility that a user may lose his or her balance. The support structure may be designed to support the back or buttocks of the user, and may be adjustable in one or more directions, such as up/down, right/left, and forward/back. For example, as shown in Fig. 5D, support 60 may rest on a pole 63 that pivots forward and backward in the direction of arrow Z, and support 60 may further be adjustable up and down the pole along arrow Y. Other mounting means for support 60 may also be used, however, such as a crossbar behind the user supported by a pair of posts. Any means for mounting the support may be used, but optimally should not interfere with the natural, free-swinging arm motion of the user. In an exemplary exercise bicycle embodiment 550, back support 60 may comprise a back rest

that is part of the seat 62, as shown in FIG. 5E. Support structures may be particularly desirable for machines where there may be a risk of imbalance or instability, such as, for example, with an elliptical machine 520, trampoline 530, stepper 540, torso-twisting disk 560, or air glider 570, as shown in FIGS. 5B-5D, 5G, and 5H, respectively, where the user is in a somewhat elevated position when using the machine. Support structures are not limited to use only with these machines, however, and may be provided on any machine, including but not limited to treadmills. Embodiments without such a support structure may also be provided for any type of machine.

The resistance provided by the exercise device is preferably unidirectional, preferably provided on the forward arm swing as shown in FIGS 1A, 1B and 5A-5E, 5G, 5H, 8, 9, and 12. The unidirectional resistance allows for two phases of exercise: an exertion phase (on the foreswing for rear-mounted devices) and a resting phase (on the backswing for rear-mounted devices). As shown in FIG. 5F, however, reel 12 may also be used to provide resistance for backward arm motion, such as for use with a rowing machine 560. Reels 12 or 112 may be used to provide resistance to forward or backward arm motion on any exercise machine known in the art. Although reel 112 is generally known for providing upper body exercise in conjunction with a cross-country ski machine, it has not been known for use with other exercise machines. Accordingly, it is within the scope of this invention to use reel 112 to provide resistance to forward arm motion when mounted to any exercise machine and to provide resistance to backward arm motion when mounted to any exercise machine other than a cross-country ski machine. Furthermore, the scope of this invention includes the use of any source of multi-planar (non-pole-type) arm swing resistance on any lower body exercise machine other than a treadmill or a cross-country ski machine and the use of any source of multi-planar (non-pole-type) arm swing resistance permanently integrated with a treadmill. By "permanently integrated" it is meant that the arm-swing resistance is not a retrofit unit. Thus, this invention serves needs and fills gaps currently not addressed by existing exercise machines on the market.

A plurality of reels 12 may also be used to provide bi-directional resistance both on the forward and backward swing. An exemplary bi-directional

resistance design, shown in FIG. 5B, shows one reel 12a in front of the user and one reel 12b behind the user for each arm. The user may optionally use both reels 12a and 12b at the same time to provide resistance on the upswing and backswing, or may only use one reel at a time, to provide resistance on the upswing or the backswing, depending upon user preference. Although shown in FIG. 5B with use on an elliptical machine 520, the bi-directional resistance design is not limited to use on elliptical machines, nor are elliptical machines limited only to bi-directional designs.

Preferably the arm exercise mechanism has at least one anchor point for each reel 12. The anchor point or points may be located anywhere, but are preferably located on the exercise machine itself, as shown in FIGS 1A-1C, 5A-5H, 7-9, and 12. The anchor point may be located on the base or lower frame of the exercise machine, and preferably to the rear of the user at a height within a range between and including the user's feet to the user's hips, as shown, for example, in FIGS 1A-1C and 5A-5E, 5G, 5H and 7. In other embodiments, discussed herein later, the anchor point for the resistance device may actually be located somewhere other than behind the user, with guides used for bringing the cables to the rear of the user. Reels 12 may be detachable or permanently or semi-permanently anchored. The attachment mechanism at the anchor point may be a quick-connect mechanism that allows for reels 12 to be quickly replaced or moved easily from place to place around the machine, from machine to machine, or from machine to non-machine or free-standing locations. The attachment mechanism may also be a standard bolt and nut combination (with washers or special brackets as needed to adapt to each machine). The attachment mechanism may be adapted for easy detachment by the user, or may be intended to remain fixed without routine detachment by the user.

Reels 12 may also be used in a free-standing mode. For example, one or more reels 12 may be mounted to any type of floor 600, wall 610, ceiling 620, pole, bench, or the like in a gym or home at a desired height to provide an arm and/or leg workout, as shown in FIGS. 6A-C. Cable 217 may have hand loops 219 as the user interface as shown and described previously, or may have a crossbar 619 similar to a weight-lifting bar on which weights are typically mounted.

In another embodiment, as shown in FIG. 6D a pair of reels 12 may be mounted on a platform 50 on which a user 14 may stand, with the opposite end comprising any of the user interfaces described previously. A user standing on platform 50 may thus approximate a curling or lifting exercise using free weights using the reel mechanisms of this invention, optionally with a bar (such as crossbar 619 shown in FIGS. 6A-C). A user lying on his or her back on platform 50 between reels 12 with a crossbar 619 connected to the respective cables may approximate a bench press exercise. A single reel 112 may also be used in a freestanding mode with or without a platform 50, as shown in FIG. 6E mounted on a platform. Single reel 112 may be mounted at an angle or on a swivel or cable guides may be used so that the pulling force is always perpendicular to the axis of the spool for smooth operation regardless of the height or position of the user. In one embodiment (not shown), the platform may be relatively small, with just enough size for the user to stand on, such that the user typically must keep one foot down at all times to prevent the platform from moving. In another embodiment, shown in Fig. 6D, the platform may be relatively large and heavy. An advantage of a relatively large, heavy platform is that the platform does not rely on the user stepping on it to keep it in place. Thus, the user may run in place, jump, stretch, perform kneebends, or other lower body exercises while using a relatively heavy platform. Although some lower body exercises may be possible in conjunction with upper body exercise on a lightweight platform, exercises such as jumping and running in place are not readily facilitated.

Reel 12 may also be used to exercise other body parts, such as the legs, in a natural motion. In one embodiment, loop 219 may be placed around the user's foot or leg, as shown in FIG. 6F and the user may perform leg lifts with a natural motion. For example, reels may be connected to a platform 50 and the user may position himself or herself against a wall 610 for balance. Such exercise may be beneficial for developing leg muscles above the knee and muscles in the waist and buttocks, and may further provide an enhanced aerobic workout. The use of reels for leg exercises is not limited to freestanding reels as shown in FIG. 6F, however, but may include reels mounted to exercise machines, benches, poles, walls, floors, and the like. The uses of the reels of this invention are not limited to exercising leg and arm muscles, however, as other

muscles may also be exercised, such as muscles in the neck, midsection, shoulders, waist, and the like. Neck muscles may be exercised, for example, by using a headband as the user engagement means.

Thus, in one aspect, the subject invention solves a number of the problems associated with present dual action machines in one simple, compact, economic, easy-to-use mechanism. Embodiments including placement of the mechanism behind the user allow for a more natural, free-swinging arm motion and promotes a more natural, upright body position, which is safer for the user. The natural, free-swinging motion promotes better overall body coordination during exercise, as the upper body typically sets the rhythm for performing the exercise. As compared to pole-type mechanisms, the present invention provides a more flexible and versatile range of motion, allowing the user to choose the amount of upswing and backswing distance most comfortable for him or her and to choose the plane of motion relative to body most comfortable. Furthermore, the user may choose between dual action or non-dual action mode, and in some embodiments, unidirectional or bi-directional resistance.

The use of a padded, non-chafing loop for engaging the hand provides a more comfortable engagement than a grip, exerting less pressure on the hand or wrist. The loose or open grip of a padded loop also avoids the undesirably higher blood pressure that, according to some sources, may be promoted by a closed grip. An adjustable and/or padded cuff 1210 that merely slips around the user's wrist, such as shown in Fig. 12 may also be used to avoid the drawbacks of a closed grip. The hand loop 219 may be used as a cuff around a user's wrist, if desired. The arm exercise mechanisms discussed herein, such as reel 12, are relatively inexpensive to manufacture and are relatively easy and inexpensive to repair or replace. The mechanisms discussed herein are also lightweight and are compact for storage.

Other mechanisms besides reel mechanisms may also be used to provide total body workouts on lower-body-focused exercise machines. The use of elastic members for enhancing a workout is taught generally in U.S. Patents No. 5,405,305, No. 5,476,431, and No. 5,632,708, incorporated herein by reference. As used herein the term "elastic member" refers to any type of exercise bands, tubing, ropes, or cords

known in the art that provide resistance to being stretched, and include any type of materials of construction, including natural and synthetic materials. Elastic members can also be made to have an adjustable resistance force. For example, by shortening the length of the elastic member that is allowed to stretch, the resistance provided by that member can be increased. Devices are known in the art to provide such shortening capability with relative ease of adjustment. One such device for use with exercise tubing is described in U.S. Patent No. 5,108,096 to Ponce, incorporated herein by reference, and another such device is marketed by Innotrainer of Tanumshede, Sweden, as described generally with respect to adjusting the distance between handles for aerobic exercise on www.innotrainer.com, also incorporated herein by reference. Thus, a pair of adjustment devices may be mounted to the frame of an exercise device, such as in the position of reels 12 shown in Fig. 7, and elastic members may be used to provide the resistance from behind the user.

Another mechanism for providing adjustable resistance with elastic members is to use a plurality of elastic members, with the ability to engage or disengage selected members to increase or decrease the resistance force. Use of the adjustable and/or padded user engagements described herein may be particularly advantageous over standard user engagements typically used with such elastic members, for all of the reasons discussed herein.

Although described above with respect to self-contained resistance mechanisms mounted behind the user, the resistance mechanism may be mounted elsewhere on the machine and directed to a point behind the user with rollers, pulleys or guides. For example, as shown in Fig. 8, the resistance mechanism may comprise an elastic member or helical spring 800 mounted underneath the machine, with guides such as rollers or pulleys 802 for directing the cable to the user. Adjustability of the amount of resistance may be provided by increasing or decreasing the amount of pre-stress on the spring or elastic band, such as by shortening the length of the spring or band allowed to expand as a result of the workout, or by preloading the spring or band. An exemplary method of adjusting the preload on a helical spring is shown in Fig. 20 of U.S. Patent No. 6,123,649, incorporated herein by reference. The spring or elastic member may be

enclosed in a tube if desired for aesthetic or safety purposes. Only one helical spring mechanism 800 is shown in Fig. 8, but it should be understood that optimally there is one spring mechanism for each arm to provide independent resistance. One embodiment (not shown), however, may comprise a single spring configured so that each end of the single spring serves as a spring mechanism for one of the arms.

As shown in the treadmill embodiment of Fig. 9, a single reel 112 may also be mounted in front of the user or under the machine with guides such as pulleys 900 and stays 902 provided for guiding the cables to a point behind the user to provide an exercise workout for the natural arm swing of the user.

When used with a treadmill, the resistance devices of the present invention provide an increased workout without requiring, for example, an inclined or motorized treadmill. The resistance devices of the present invention also enable a natural, free-swinging motion when walking or running on the treadmill. Thus, the relatively inexpensive addition of resistance mechanisms may eliminate the need for more expensive mechanisms, such as inclines or motors, typically used with treadmills known in the art. Of course, the resistance mechanisms may also be coupled with inclined and motorized treadmills for an even greater workout.

As described herein, one aspect of the invention comprises an exercise machine for exercising a user, the machine comprising an upper body exercise component comprising one or more resistance devices adapted to provide resistance to a forward swinging motion of an arm of the user while allowing the user's arm to perform the natural, free-swinging forward motion in a naturally extended arm position. The resistance device comprises a elongated tension member having first and second ends and a user engagement connected to the elongated tension member first end, wherein the user engagement is padded, adjustable, or a combination thereof. Although the resistance device is preferably the exercise reel described herein, or one of the other resistance systems described above, any resistance device known in the art may be used in conjunction with such an exercise machine. For example, the following U.S. Patents describe exemplary resistance mechanism, all of which may be used to provide resistance for the upper body workout: U.S. Patents No. 518,967 to Poole; No.

3,929,331 to Beeding; No. 4,114,875 to Deluty; No. 4,557,480 to Dudley; No. 4,779,866 to Marshall et al.; No. 5,147,264 to Braathen; No. 5,176,599 to Beliakov; No. 5,486,149 to Smith et al.; No. 5,618,249 to Marshall; No. 5,733, 231 to Corn et al.; Nos. 5,876,310 and 6,149,559 to Mackey, and No. 6,123,649 to Lee et al. This list is not limiting, however, as a multitude of other resistance devices are known in the art, and applicable for use as described generally herein.

Using resistance devices to provide upper body workouts on machines otherwise designed for lower-body workouts, provides greater exercise in less time, enabling a total body workout with more aerobic benefit. The increased exercise provides increased calorie consumption, as compared to equal time on a machine without the additional resistance mechanisms, ultimately leading to increased weight loss for those incorporating exercise into a weight loss regimen. The resistance devices also provide strengthening, toning, shaping, and stretching of the muscles using the devices.

Although described primarily herein where the resistance devices are independent from the lower body workout, the upper body resistance devices may be dependent upon the lower body exercise device. For example, as shown in Fig. 12, in a stepper-type machine 1200, each resistance unit 12 may be attached to one of the steps 1202 so that the stepping motion and upper body exercise motion are tied together. The feature of making the upper body exercise dependent on the lower body exercise may also be extended, as applicable, to any of the exercise machines discussed herein.

The resistance devices may be provided as original equipment on an exercise machine, or provided as retrofit units. Retrofit units may have components allowing universal or near-universal attachment to any machines known in the art.

Reels 12 as shown in FIGS. 2A and 2B have a manual resistance adjustment effected by turning knob 216. It should be understood that the resistance adjustment may also be motorized, such as with a remote control that activates a motor which turns shaft 214. Motorized adjustment also enables adjustment of the resistance "on-the-fly", such as with a remote control integrated into the user engagement, or provided on the exercise machine, such as on a panel in front of or beside the user.

Thus, the user may increase or decrease the resistance without stopping the exercise. The remote control may be provided by a knob or push button. For knob control, turning the knob one direction may increase resistance whereas turning the knob the other direction may decrease resistance. In push button embodiments, dual or single push button control may be provided. In a single button mode, the adjustment may continuously run through a loop of increasing and decreasing resistance when the button is depressed, such that the user need merely hold the button down until the desired resistance is achieved. In a dual button mode, one button increases resistance and the other button increases resistance. Mechanical, as opposed to electrical, on-the-fly adjustment mechanisms may also be provided.

Although the devices as described herein for use with exercise machines have numerous advantages, one of the advantages is providing freedom of movement in multiple planes, which is typically not provided by the types of poles typically included for upper body exercise on lower-body exercise machines. Poles may be provided, however, that enable this functionality. In one embodiment, for example as shown in Fig. 10, a pole 1000 may be mounted axially on a heavy-gauge helical spring 1002 to enable movement in more than one plane. Resistance adjustment may be provided by adjusting the length of the portion of the spring allowed to bend. In another embodiment, shown in Fig. 11, pole 1100 may have a ball 1102 at the end that mounts in a socket 1104, with an adjustable member, such as a compression screw 1106, for adjusting the radial pressure on the ball for increasing and decreasing the resistance to movement of the ball within the socket. In some embodiments, to overcome the disadvantage of typical pole grips 1108 (shown on pole 1100), a user engagement 219 as described herein may be attached to the poles (illustrated with respect to right pole 1110), with an elastic or spring member 1112 provided to increase resistance and to provide a retraction mechanism for the pole on the backswing.

The various embodiments described herein lend themselves to novel methods of exercising, including any exercise using the physical embodiments. A particularly novel exercise method comprises exercising the upper body with a natural, free-swinging arm motion, wherein resistance is provided to the arm motion by a

resistance device providing tensioned resistance from a point of origin behind the user, and the resistance device is engaged by the user's upper body by means other than a closed grip, for example engagement by the hand in an open, loose grip such as provided by a hand loop described herein. The various exercise methods may comprise combining the upper body exercise with a lower body exercise, such as provided by any of the exercise machines discussed herein. The methods of exercise may include performing warm-up exercises, aerobic and/or strength training exercises, or cool-down exercises, and preferably may comprise a combination thereof integrated into an exercise program.

Although various embodiments of the invention have been described, it will be understood that the invention is not limited to these embodiments, but is capable of numerous modifications of parts, elements and materials without departing from the invention.